Space Weather Technical Forecast

Issued on Monday, 18 April 2022 at 01:20 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: M-class flares Likely throughout (R1/R2 Radio Blackouts). Active Electron Fluence Likely.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity is High with an X1.1 X-ray flare observed at GOES16, peaking at 17/0334UTC. This emanated from the newly-arrived AR2994 in the northeast quadrant. This event was associated with a Type-II radio burst and an estimated ejecta velocity of 614km/s. A moderately fast-moving CME was in evidence in available coronagraph imagery, however analysis suggests this is likely to pass behind the track of the Earth in its orbit to no effect.
There are currently five numbered sunspot groups on the Earth-facing side of the sun, including the aforementioned AR2994. This region occupies a particularly busy portion of the disc, which may yet prove still more densely populated when the viewing angle improves, with far-side imagery suggesting further detail may arrive in coming hours. For now, AR2994 appears as an Eki/Beta. To its immediate north, there is at least one and possibly two groups, currently amalgamated into AR2993, a Chi/Beta-gamma. These groups dominate the current disc in terms of areas and complexity, however there are two other regions of note: firstly AR2992 in the southwest Dso/Beta approaching the limb and AR2990 showed some slight intermediate spot proliferation and is classified Dri/Beta. The final group on the disc was AR2991, a simple, stable unipolar Hsx/Alpha in the southeast.
There were some peripheral (i.e. limb-generated) Coronal Mass Ejections (CMEs) in the period, the largest and most notable of which was generated by the aforementioned X-flare. At present there are thought to be no Earth-directed CMEs in available imagery.

Solar Wind / Geomagnetic Activity: The solar wind, as observed by DSCOVR and ACE at L1 was slightly elevated to elevated due to ongoing fast wind influence of CH74 and CH75, with the phi angle accordingly mostly positive (away from the sun). The density was mostly near average and close to 10ppcc. The IMF peaked at 11nT, while the north-south component varied between -8 and +11nT. The net result of the above solar wind measures was Quiet to Unsettled geomagnetic activity.

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV) measured at GOES-16 at GEO was at Background levels, with no discernible response from the X-class flare, perhaps because of its eastward location.
The high energy electron flux (greater than 2 MeV) showed a slight rise in its diurnal trend in the period, varying between Moderate and High levels and peaking at 2310pfu at 17/1705UTC. The associated 24-hour electron fluence has been below the Active threshold throughout, but showing an overall rising trend, with observed fluence of 5.45e7 integrated pfu at 18/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be Moderate through the period, primarily due to active region AR2994 and AR2993 that have recently rotated onto the northeast disc. There is a

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daily Chance (40%) of further X-class flares. No significant groups leave the disc in the four days, however the northeastern limb may yet be bolstered by further arrivals - with detail to follow.

Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs in the current forecast. Earth is embedded within the fast winds related to CH74/+ and CH75/+. Confidence is low regarding the strength and timing of enhancements, however a modest decline is probable from day 2 (19 April) onwards. Geomagnetic activity is anticipated to be quiet to unsettled with a chance of active intervals.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to be at Background levels, with just a slight increase in probability by the end of the period as AR2993 and AR2994 move westwards across the Earth-facing solar disc.
The high energy electron flux (greater than 2 MeV) is expected to persist at Moderate to High levels, although drop-outs are possible. The associated 24-hour electron fluence is likely to rise to be close to the Active (1e8 pfu) threshold by day 2 (19 April), with a probability that a slow decline will then follow later in the period.

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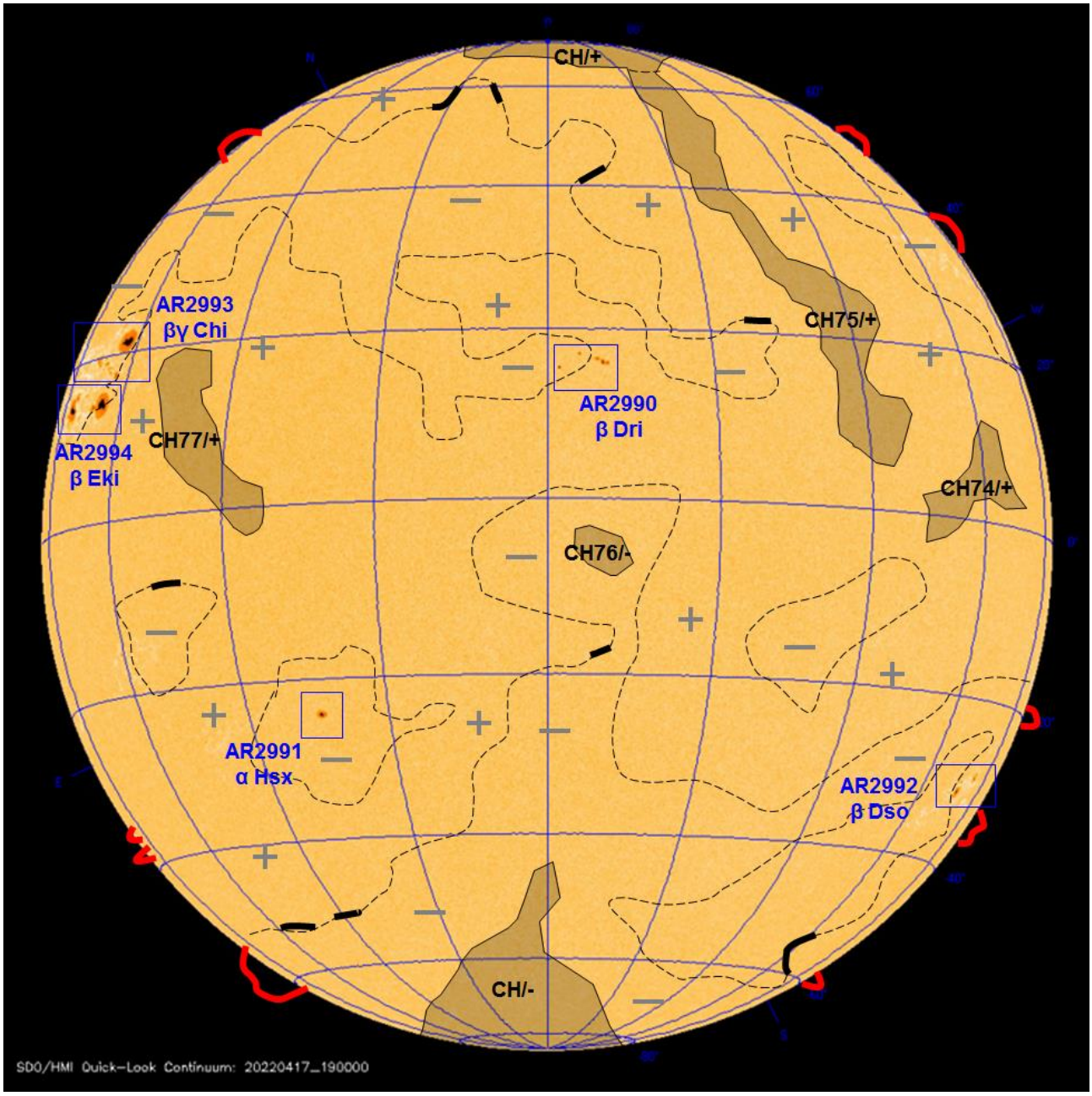
Figure 1. Solar Analysis Valid 2000UTC, 17 April 2022.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

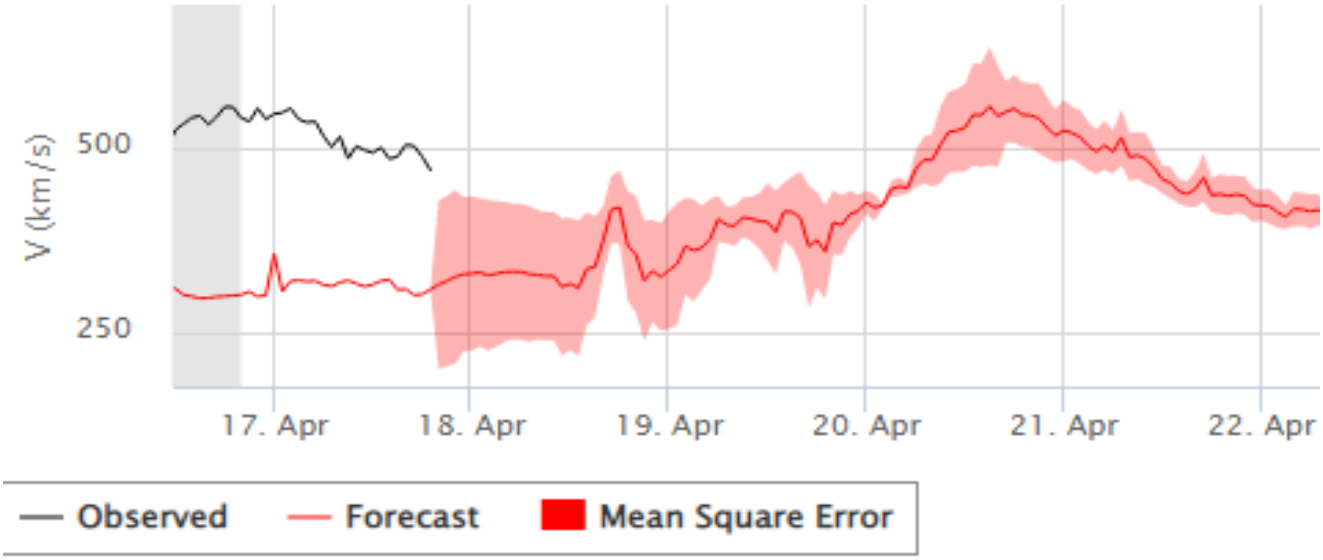
There are no Earth-directed CMEs in the current forecast.
Earth is currently in the elevated fast winds related to CH74 and CH75. These solar winds will probably decline for a time before a further fast wind arrival is possible on day 3 (20 April), from the small CH76/- centre disc. The timing and strength of these features are low confidence however, with only the final of the three holes featuring in persistence data, while the ever-decreasing upwind sampling (in the Parker spiral) from STEREO-A is not providing any useful steer for being out-of-range.
Geomagnetic activity is forecast to be mostly Quiet to Unsettled, with fast wind enhancements through the period giving a daily Chance of Active intervals. Chances for enhancements are perhaps lower from day 3 (20 April). Finally, the period is rounded out by a potentially greater risk on day 3 (20 April), when the recurrent coronal hole arrives (CH76).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	5	10	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil.

Figure 2: Met Office Solar Winds prediction Model (SWPM),



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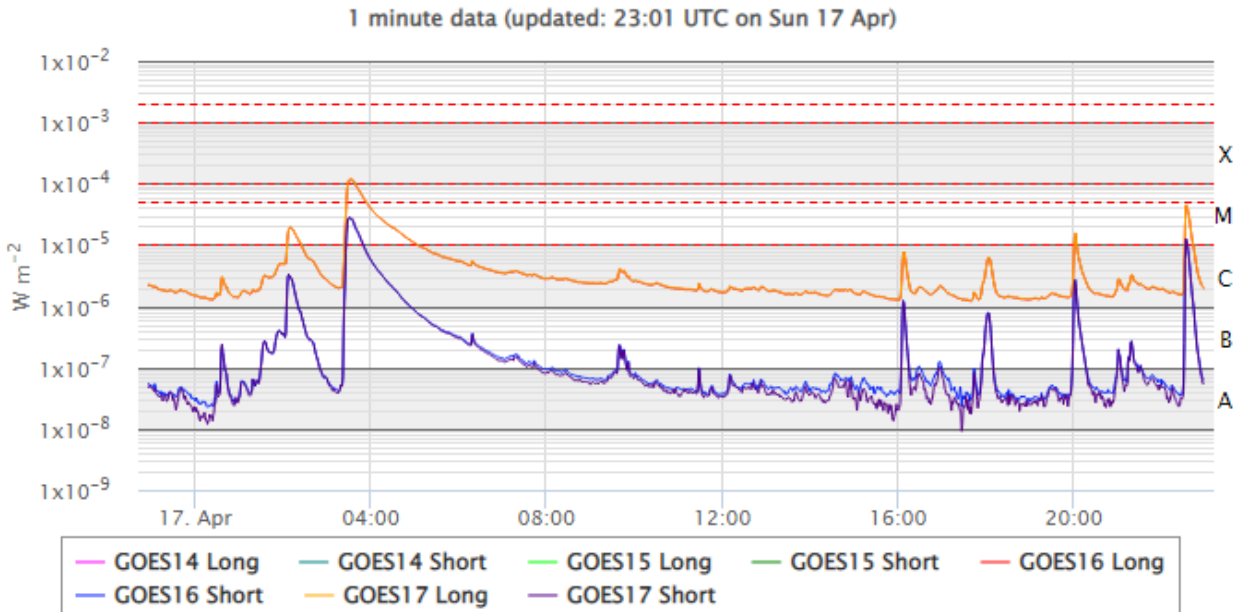
Radio Blackouts - X-Ray Flares:
Solar Activity is expected to be Moderate, with further M-flares (R1/R2 Radio blackouts) each day, primarily from new active regions in the northeast. These also bring a (40%) Chance of X-class flares (R3 radio blackouts). This is increased above suggested raw values for the current sunspot's (AR2994) obvious active history (yesterday's X1.1 and recent M-class flares. As previously noted, further complexity is expected to become apparent as they rotate into full view, with their current analysis likely to change. This is supported by STEREO-A EUVI 195 imagery which shows a broad area of bright flux, and magnetic looping in the northeast disc, along with notable magnetic looping visible in SDO AIA products.
Finally, regarding the balance of active regions on the disc, only AR2992 is expected to leave the Earth-facing side in the period, and this does not contribute appreciably to the risk of large flares - the daily probability of flares are therefore held relatively high throughout.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	80	80	70	70
Very Active	R3 to R5 X Class	Yes	40	50	50	40

Figure 3: X-ray flux at GEO in the past 24 hours with a number of flares observed.



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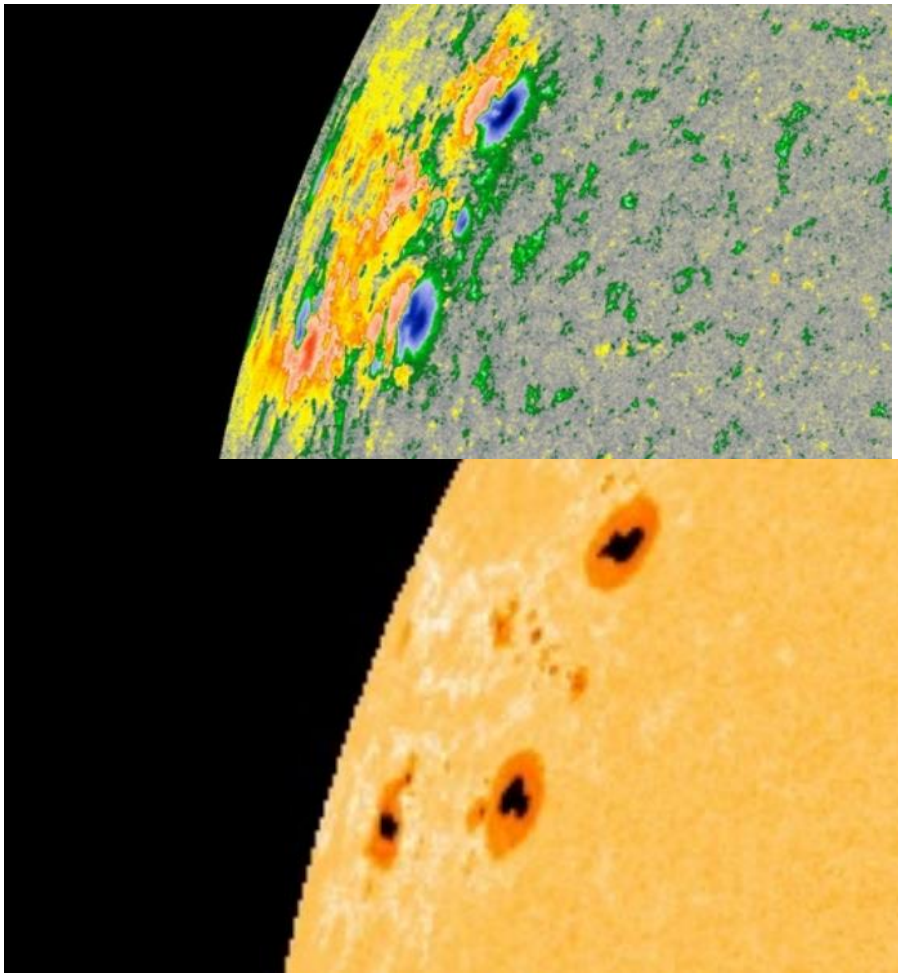
Solar Radiation Storms - (High Energy Protons):
The high energy proton flux (greater than 10 MeV) as measured by GOES-16 at GEO is at background levels, and is most likely to remain so through the next four days. New regions in the northeast have the potential to be followed by a further region(s) associated with Ex-2975 and/or Ex-2976, which had a history of producing S1 proton events on the previous rotation. As they continue to move into a slightly more favourable location for any such proton events to be observed by Earth, the potential for S1 or above storms increases.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	5	5	10	20
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: AR2993 and AR2994 located close to the northeast limb of the visible disc.



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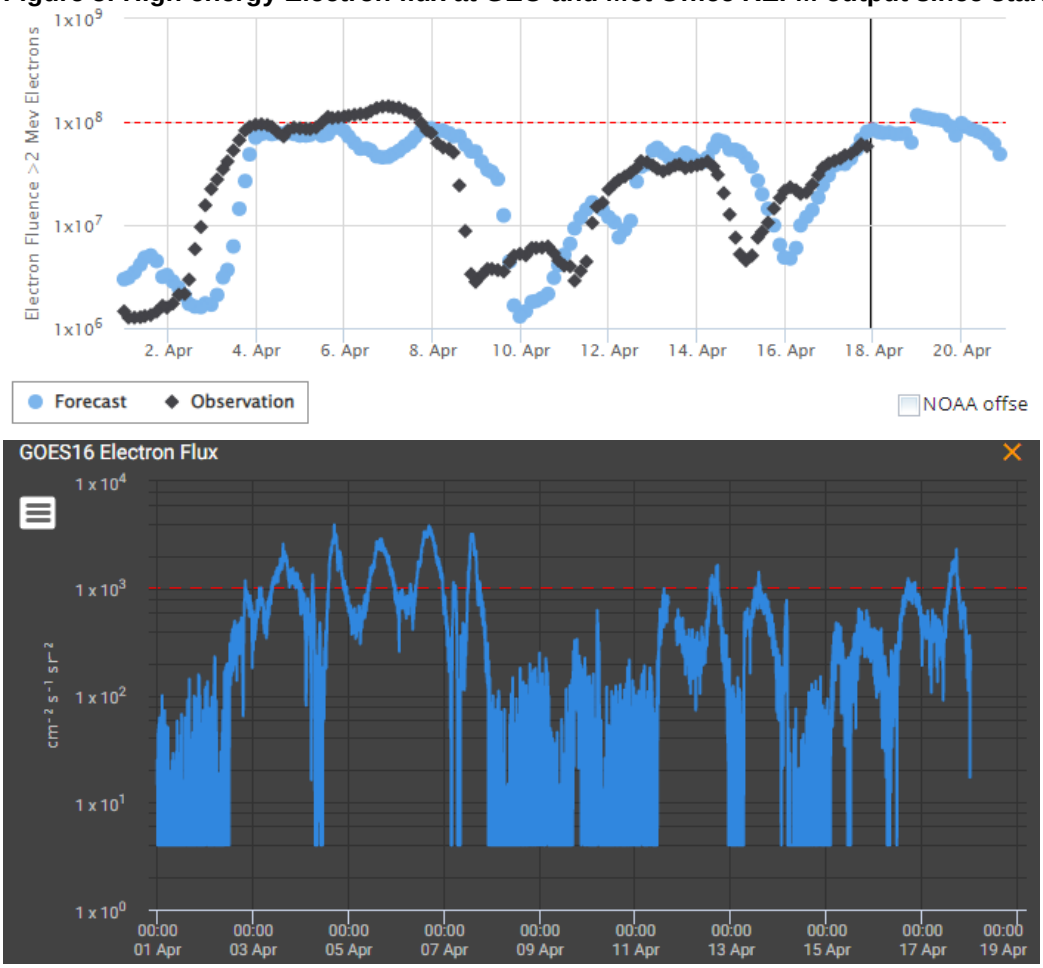
High Energy Electrons Event (≥ 2MeV):

The high energy electron flux (greater than 2 MeV) as observed by GOES-16 at GEO has risen to a higher baseline in the past 24 hours to peak at High levels. Peak values are expected to rise to high levels through the period. Drop-outs are possible with induced geomagnetic activity as successive fast wind arrivals occur, although the timing and strength of these are low confidence. Recovery of flux levels are likely to follow any falls, but with decreased confidence for reaching High levels, especially by day 3 (20 April).

The associated 24-hour electron fluence is currently on a rising trend, with REFM giving reasonable guidance. Fluence may continue to rise close to the Active (1e8) threshold in coming days. However confidence becomes low by day 3 (20 April), with potential fast wind arrivals and subsequent flux declines are possible.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	50	70	70	60
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 5: High energy Electron flux at GEO and Met Office REFM output since start of the month.



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